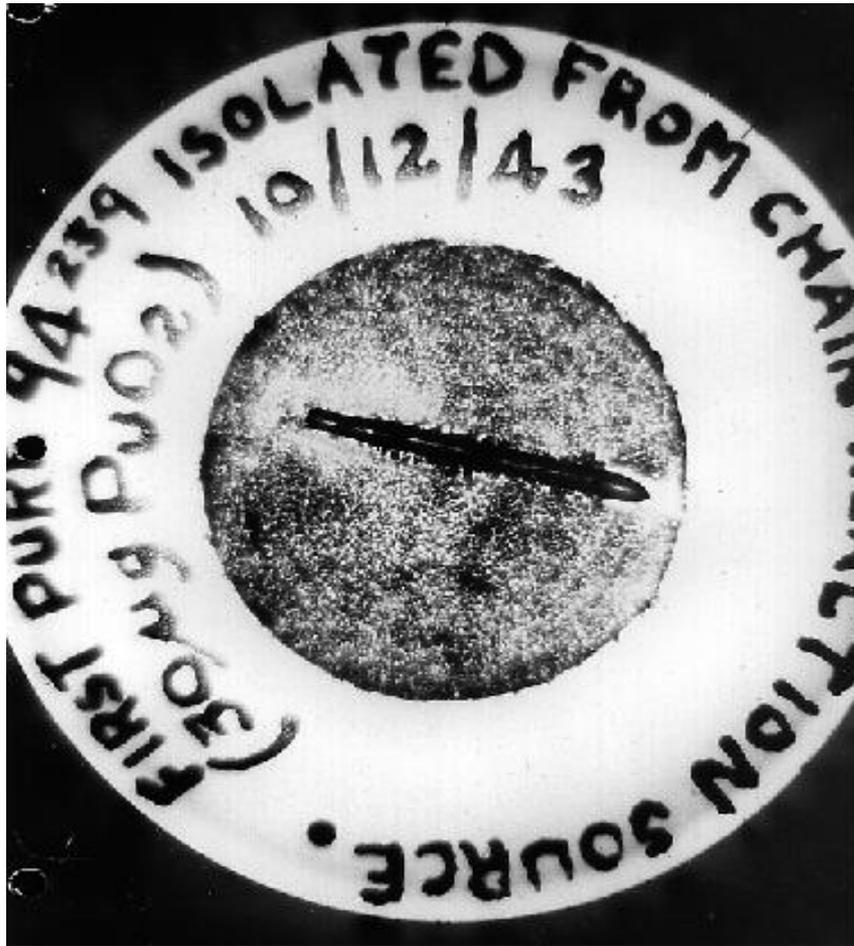


**Invited Presentation to  
The Blue Ribbon Commission on America's  
Nuclear Future**

**Public Meeting of the Subcommittee on  
Transportation and Storage  
Washington, DC, 23 September 2010**

**by Gordon Thompson  
IRSS & Clark University  
<gthompson@irss-usa.org>**

# Plutonium Inventories

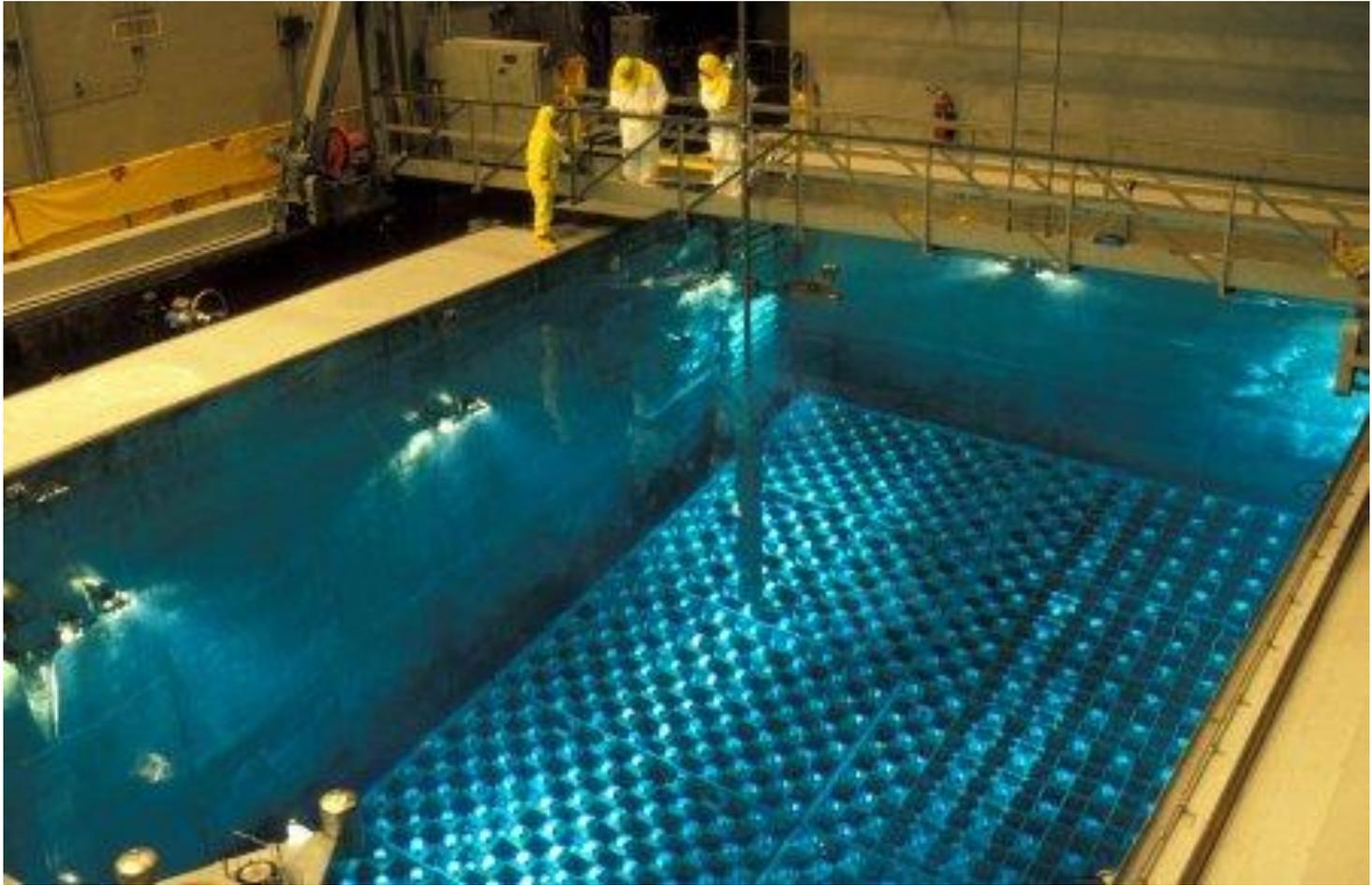


**Chicago, 1943:**  
**30 microgram (oxide)**

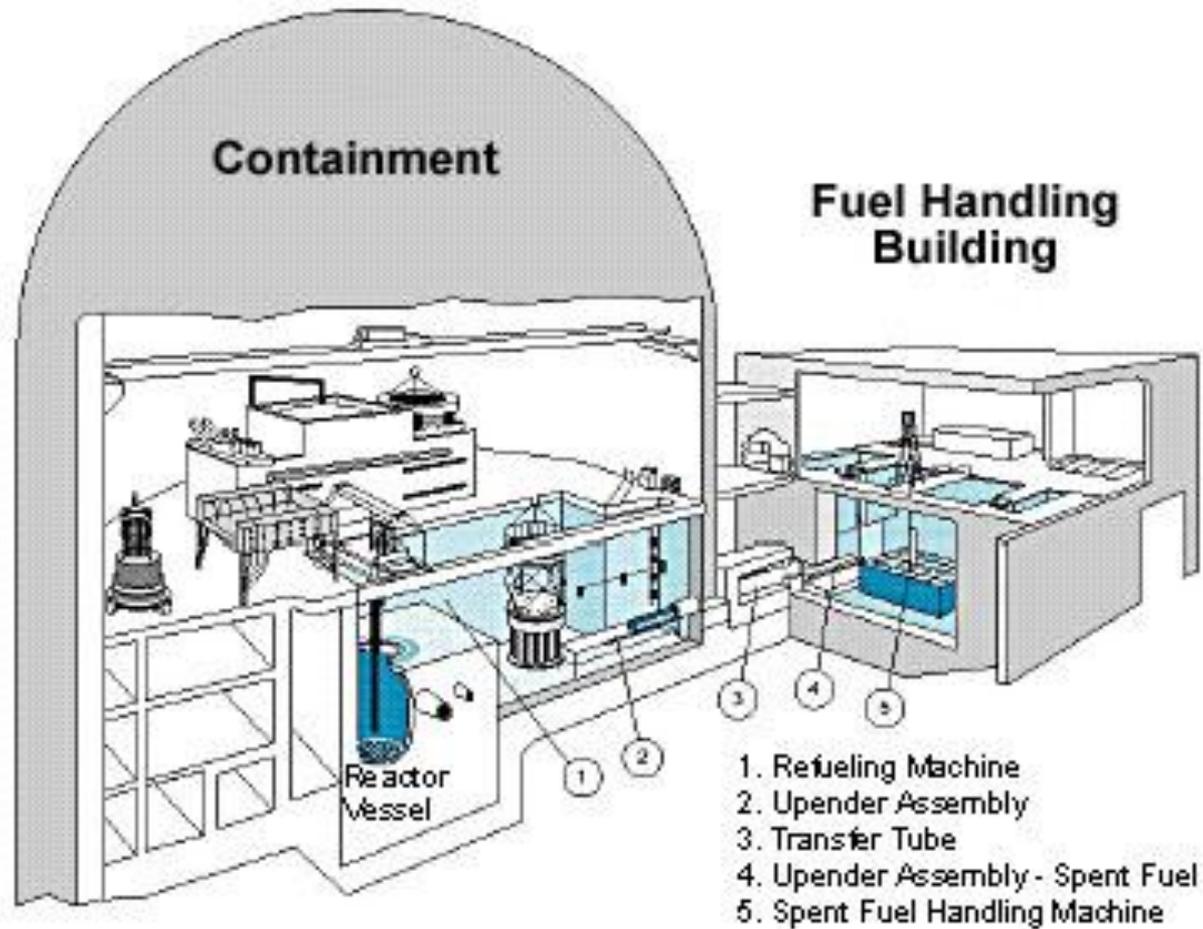
**One nuclear warhead:**  
**3 to 4 kg (average)**

**Produced by commercial  
reactors worldwide,  
1961 through 2010:**  
**2.1 million kg**

# A Spent Fuel Pool



# Typical PWR Layout



# A Dry Storage Module



# Shaped Charge Warhead, 1943



*Above: The RPG 1943 was the Soviet equivalent of the German Wurfmine, but it used a fabric strip stabilizer tail to keep the hollow charge warhead pointing towards the target tank when in night. The tail was ejected from the throwing handle after the grenade had been thrown and after the arming pin had been removed.*

# Performance of US Army Shaped Charge M3 (from FM 5-25, 1967)

| Target Material     | Indicator   | Magnitude  |
|---------------------|---|--|
| Reinforced Concrete | Maximum wall thickness that can be perforated           | 60 in  |
|                     | Depth of penetration in thick walls                     | 60 in  |
|                     | Diameter of hole  | <ul style="list-style-type: none"> <li>• 5 in at entrance</li> <li>• 2 in minimum</li> </ul> |
|                     | Depth of hole with second charge placed over first hole | 84 in  |
| Armor plate         | Perforation   | At least 20 in   |
|                     | Average diameter of hole                                | 2.5 in   |

# The Mistel Shaped Charge Delivery System, 1944



Junkers Ju 88 mit  
Messerschmitt Bf 109

*Gegen Ende des Krieges war die Ju 88 die Maschine, welche am häufigsten zur unteren Einheit des Mistelsystems umgebaut wurde. Einige behielten für Erprobungsflüge ihre Kanzeln, bei anderen, wie hier im Bild, war bereits der massive Sprengkopf montiert.*

# Bunker Busting with Clustered Shaped Charges, 2008



# **National Infrastructure Protection Plan**

## **Purposes of Protective Measures**

- Deter the threat
- Mitigate vulnerabilities
- Minimize consequences

## **Types of Protective Measures Include**

- Hardening facilities
- Building resiliency and redundancy
- Incorporating hazard resistance into initial facility design
- Initiating active or passive countermeasures

**From: “Strategic National Security Challenges  
Facing the United States”**

**by General (Ret) Barry McCaffrey, August 2010**

*Protecting US Critical Infrastructure*

“It is impossible to defend everything against every conceivable threat. We must move beyond gates, guards, and guns. We need to design security features into new infrastructure. We need new technology to protect potentially high-casualty targets.”

**Statement by NRC Chair  
Richard Meserve, 2002**

**Paper in *The Industrial Physicist*,  
Oct/Nov 2002**

“We cannot eliminate the terrorists’ targets, but instead we must eliminate the terrorists themselves. A strategy of risk avoidance – the elimination of the threat by the elimination of potential targets – does not reflect a sound response.”

# **Some Options to Reduce Spent Fuel Storage Risk**

## **Spent Fuel Pools**

- Revert to low-density, open-frame racks
- Transfer excess fuel to dry storage

## **Dry Storage Modules**

- Harden the modules
- Beware of creating a repository by default

# Schematic of One Approach to Hardening a Dry Storage Module

